

# Claims

[c1] What is claimed is:

1.A printing apparatus comprising:

a printhead comprising:

a plurality of first heating elements for heating ink supplied to the printhead to generate bubbles in the ink and eject the ink through corresponding nozzles; and

a second heating element for heating the ink supplied to the printhead, a resistance value of the second heating element being less than the resistance value of each first heating element, the low resistance value of the second heating element causing the second heating element to burn out and create an open circuit if the volume of the ink is less than or equal to a predetermined level; and an ink volume detecting circuit electrically connected to the second heating element for determining if the volume of the ink supplied to the printhead is less than or equal to the predetermined level based on a condition of the second heating element.

[c2] 2.The printing apparatus of claim 1 wherein the second heating element corresponds to a dummy nozzle formed on the printhead.

- [c3] 3.The printing apparatus of claim 1 wherein the ink volume detecting circuit comprises a current measuring circuit for measuring a current flowing through the second heating element to determine the condition of the second heating element.
- [c4] 4.The printing apparatus of claim 1 wherein the ink volume detecting circuit comprises a voltage measuring circuit for measuring a voltage across the second heating element to determine the condition of the second heating element.
- [c5] 5.The printing apparatus of claim 1 further comprising a switch electrically connected between the second heating element and the ink volume detecting circuit, the switch being controlled by a control circuit of the printing apparatus for selectively activating the ink volume detecting circuit.
- [c6] 6.The printing apparatus of claim 5 wherein the control circuit of the printing apparatus comprises a maintenance circuit for controlling the switch to activate the ink volume detecting circuit during a nozzle maintenance period of the printhead.
- [c7] 7.The printing apparatus of claim 1 wherein the first heating elements and the second heating element are

composed of a tantalum–aluminum (TaAl) alloy.

[c8] 8.The printing apparatus of claim 1 wherein the first heating elements and the second heating element are composed of poly–silicon, Titanium Nitride (TiN), or tantalum nitride (TaN).

[c9] 9.The printing apparatus of claim 1 wherein a temperature of the ink supplied to the printhead increases as a volume of the ink decreases, and a high temperature of the ink when the volume of the ink is less than or equal to the predetermined level causes the second heating element to burn out before the first heating elements.

[c10] 10.A method for heating a printhead in a printing apparatus, the printing apparatus comprising a printhead having a plurality of first heating elements for heating ink supplied to the printhead to generate bubbles in the ink and to eject the ink through corresponding nozzles; the method comprising:  
heating the ink supplied to the printhead with a second heating element, a resistance value of the second heating element being less than the resistance value of each first heating element, the low resistance value of the second heating element causing the second heating element to burn out and create an open circuit if the volume of the ink is less than or equal to a predetermined

level; and

analyzing a condition of the second heating element to determine if the volume of the ink supplied to the print-head is less than or equal to the predetermined level.

[c11] 11.The method of claim 10 wherein the second heating element corresponds to a dummy nozzle formed on the printhead.

[c12] 12.The method of claim 10 wherein analyzing the condition of the second heating element comprises measuring a current flowing through the second heating element to determine the condition of the second heating element.

[c13] 13.The method of claim 10 wherein analyzing the condition of the second heating element comprises measuring a voltage across the second heating element to determine the condition of the second heating element.

[c14] 14.The method of claim 10 further comprising controlling a switch to analyze the condition of the second heating element at a predetermined time.

[c15] 15.The method of claim 14 further comprising controlling the switch to analyze the condition of the second heating element during a nozzle maintenance period of the printhead.

- [c16] 16.The method of claim 10 wherein the first heating elements and the second heating element are composed of a tantalum–aluminum (TaAl) alloy.
- [c17] 17.The method of claim 10 wherein the first heating elements and the second heating element are composed of poly–silicon, Titanium Nitride (TiN), or tantalum nitride (TaN).
- [c18] 18.The method of claim 10 wherein a temperature of the ink supplied to the printhead increases as a volume of the ink decreases, and a high temperature of the ink when the volume of the ink is less than or equal to the predetermined level causes the second heating element to burn out before the first heating elements.